

PROPOSAL FOR S.105 GREAT LAKES NATIONAL GEOGRAPHIC INITIATIVE FUNDING

TITLE: **DEVELOPMENT OF AN ATMOSPHERIC MERCURY
MODELING SYSTEM FOR THE GREAT LAKES
REGION**

**PROJECT
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BUDGET REQUEST: \$100,000

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Summary

The Wisconsin Department of Natural Resources (DNR) is requesting funds to develop an atmospheric mercury modeling system for Wisconsin and the Great Lakes region. Development of the modeling system will include a comprehensive analysis of the emission, transport, transformation, and deposition of mercury to land and water surfaces in the region. The modeling system will be used to support development and evaluation of the effectiveness of mercury emission reduction initiatives and strategies. These initiatives and strategies include atmospheric

mercury TMDLs (Total Maximum Daily Loads) for impaired water bodies in the state, proposed state regulations for the reduction of mercury from fossil fuel-fired utility plants, and other volunteer mercury reduction programs. The air quality analysis will improve the understanding of mercury transport and deposition in the Great Lakes region. The funds would be used for computer equipment and associated support to develop the capacity to model mercury transport and deposition. The modeling system is expected to be applicable throughout the Great Lakes region and therefore, other states, tribes, and federal agencies will directly benefit from this project. Input from other states, federal land managers, and tribes will be through the Midwest Regional Planning Organization.

Background

Mercury (Hg) is a known toxic trace element that has been declared a primary pollutant by the USEPA, the United Nations Environmental Science Committee (UNESCO), the United Nations Environmental Council of Europe (UNECE), and a trilateral Council of North American Environment Ministers. Mercury exhibits varying toxicity depending on its chemical form in the environment. Mono-methylmercury (MMHg), for example, is a neurotoxin and teratogen, which bioaccumulates up the food chain by a factor of a million or more. Human and wildlife exposure to mercury is primarily due to the consumption of contaminated fish. The risk is greatest for infants and the fetuses of pregnant women who consume mercury-laden fish. Of the 189 compounds identified as hazardous air pollutants in the 1990 Clean Air Act, mercury was singled out for separate study to examine anthropogenic (human-caused) emissions and to define thresholds at which mercury affects human health and the environment.

Mercury is an important issue for the State of Wisconsin as well as other states in the Great Lakes region. As a PBT (persistent bioaccumulative toxic) chemical that is found in terrestrial and aquatic food chains, mercury poses a risk to human health and the environment. As a result of mercury contamination, health advisories have been established for nearly all water bodies in the state restricting the consumption of certain fish. In total, 41 states in the country have some type of fish consumption advisory related to mercury contamination.

Significant progress has been made in reducing the direct discharge of mercury to water bodies by industrial and municipal sources. Much of the mercury now contaminating water bodies is the result of atmospheric deposition. Mercury released to the air can be deposited locally (very near the source) or can travel longer distances to be deposited within the Great Lakes region or on a national or global scale. To address atmospheric mercury deposition, the Wisconsin Department of Natural Resources is developing rules to reduce mercury emissions from electric utility plants, and to cap mercury air emissions from other major sources. In addition, the state has established a list of water bodies under Section 303(d) of the Clean Water Act that are impaired as a result of atmospheric mercury contamination. To meet the requirements of Section 303(d), the state as well as other states in the Great Lakes region, must establish TMDLs (total maximum daily loads) for water bodies impaired by atmospheric deposition.

2. Problem Statement

Mercury in the atmosphere can come from natural sources (geologic, oceans, forest fires, volcanoes) or anthropogenic sources (incinerators, coal combustion, industrial emissions). In its *Mercury Study: Report to Congress* released in December 1997, the USEPA found that “a plausible link exists between past and present, human-caused, atmospheric emissions of mercury

in the U.S. and increased concentrations of mercury that have been found in the environment and in freshwater fish”. However, the USEPA goes on to say that “an apportionment between mercury sources and mercury in environmental media and biota cannot be described in quantitative terms with the current scientific understanding of the environmental fate and transport of the pollutant”.

The USEPA began two pilot projects in 1999 to investigate the relationship between air emissions of mercury and water quality impacts. These pilot projects are being conducted on Devil’s Lake in Wisconsin, a small lake in south-central Wisconsin, and a portion of the Florida Everglades west of Fort Lauderdale. Both of these bodies of water are on their state’s lists of “impaired” waters, and have fish consumption advisories due to high levels of mercury in fish. The goal of the USEPA project is to examine methods for taking air sources into account when determining total maximum daily loads (TMDLs), specifying the amount of mercury that may be present in the water and still allow the lake to meet state water quality standards. For FY 2000, Wisconsin received grant funding to conduct event-sample monitoring at Devil’s Lake as a part of the pilot project.

The Devil’s Lake TMDL pilot project is expected to provide useful information on the methodology for establishing TMDLs for mercury impaired water bodies. This pilot project will also provide some insight regarding the sources and transport of mercury emissions specific to the lake. However, the state believes that additional and more detailed emissions inventory, monitoring, and modeling work will be necessary to fully understand the transport and deposition of mercury emissions to the state and Great Lakes region. In addition, Wisconsin and other states currently lack the capacity and a developed system to implement the methodology developed from the Devil’s Lake pilot project to establish regional TMDLs and assess the effectiveness of current and future mercury regulations. This proposal seeks funding to develop an atmospheric modeling system for the Great Lakes region. It will directly build upon the monitoring, emissions inventory, and modeling work currently being conducted for the Devil’s Lake TMDL pilot project.

Proposed Work and Outcomes

1) Emissions Data Development

Outcomes

- a) Insure accurate mercury emission estimates for the Great Lakes Region.
- b) Develop emissions data sets to support deposition modeling in the region.

Tasks

- a) Obtain emission data for central US and southern Canada.
- b) Quality assure emissions data and revise as appropriate.
- c) Revise emissions model to handle mercury emissions.
- d) Develop mercury emission profiles.
- e) Develop mercury emission sets for selected episodes.

2) Data Analysis

Outcomes

- a) Estimate size of area contributing to mercury deposition to the state and Great Lakes Region.
- b) Corroborate findings from Eulerian grid models.

- c) Determine temporal patterns and spatial differences in deposition.
- d) Estimate and evaluate dry deposition of mercury.
- e) Recommend improvements in dry deposition measurements.

Tasks

- a) Obtain monitoring data from states in central US.
- b) Determine the extent of the QA for the data.
- c) Conduct geographical and statistical analyses.
- d) Construct back trajectories with and without chemistry.
- e) Trends analyses.
- f) Evaluate knowledge on dry deposition.
- g) Recommend improvements to the estimates of dry deposition.

3) Conceptual Model

Outcomes

- a) Develop a conceptual model of mercury deposition combining transport, emissions transformation and deposition of mercury.
- b) Insure that the conceptual model is consistent with existing deposition data.

Tasks

- a) Develop conceptual model.
- b) Test hypotheses.
- c) Revise model as appropriate.

4) Modeling

Outcomes

- a) Simulate mercury transport, chemical transformation and deposition.
- b) Estimate effectiveness of mercury reduction initiatives and strategies.
- c) Evaluate model sensitivity.

Tasks

- a) Select model domain.
- b) Obtain and evaluate chemistry models (REMSAD and CMAQ).
- c) Install and test models.
- d) Evaluate MM5 for simulating rainfall.
- e) Evaluate and select test episodes.
- f) Run meteorological and chemistry models and evaluate performance.
- g) Conduct model sensitivity analyses.
- h) Test potential control programs.

Relevance to Great Lakes Atmospheric Deposition Priorities

The proposed project seeks to develop an atmospheric mercury modeling system for the Great Lakes region. In this capacity, the proposal is directly relevant to Great Lakes atmospheric deposition priorities listed in the FY2001 RFP (request for proposals) appendix. Atmospheric modeling is listed as one of the priorities for the Great Lakes including projects that support the development of regional mercury TMDLs for the Great Lakes states. In developing an

atmospheric mercury modeling system, the project directly supports the development of mercury TMDLs for the Great Lakes region.

Great Lakes Region Collaboration

The project will work through the Lake Michigan Air Directors Consortium, Midwest Regional Planning Organization, and Wisconsin's Clean Air Task Force to involve and receive input from other states, academia, environmental groups, local governments, tribes and federal land managers. Other states that are a part of the Midwest regional Planning organization and are participating in the project include Illinois, Indiana, Michigan, and Ohio. Specifically, the project will seek input from academic experts on monitoring and modeling mercury air emissions. The project will also work with the Great Lakes Commission and Great Lakes Regional Inventory Steering Committee to obtain mercury emissions inventory data for Wisconsin, other states, and Ontario, Canada. Currently, the Department of Natural Resources is engaged in discussions with a Wisconsin electric utility regarding participation of the company in the project.

Other funding Sources

The Wisconsin Department of Natural Resources will provide funding through in-kind support including staff time, computers, software, and consulting fees. In addition, four other states (Illinois, Indiana, Ohio, and Michigan) are participating in the project through the Midwest Regional Planning Organization and have offered in-kind support and collaboration. The Air Directors of the Regional Planning Organization recently approved funding to support mercury deposition modeling focused on the Great Lakes region. Discussions are also underway regarding the participation and funding support by a Wisconsin electric utility company. The department is also pursuing direct funding from other utilities and indirect funding from utilities through the state Environmental Research "Public Benefits" program.

Key Personnel

Larry Bruss, Department of Natural Resources, Air Management Ozone Section Chief, will act as the principal investigator for the project.

Budget

Budget Summary

FY 2002	\$85,000
FY 2003	\$15,000
Project Total	\$100,000

Capital Equipment

Computer Work Station	\$65,000
Subtotal	\$65,000

Supplies and Services

Computer Software	\$5,000
Consulting Services	30,000
Subtotal	\$35,000
Project Total	\$100,000